

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

COVER CROP

(Ac.)

CODE 340

DEFINITION

Crops including grasses, legumes and forbs grown for seasonal cover and other conservation purposes.

PURPOSE

- Reduce erosion from wind and water.
- Increase soil organic matter content.
- Capture and recycle or redistribute nutrients in the soil profile.
- Promote biological nitrogen fixation.
- Increase biodiversity.
- Weed suppression.
- Provide supplemental forage.
- Soil moisture management.
- Reduce particulate emissions into the atmosphere.
- Minimize and reduce soil compaction.

CONDITIONS WHERE PRACTICE APPLIES

On all lands requiring vegetative cover for natural resource protection and or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria (including all Federal, state, and local laws) and site conditions.

The species selected will be compatible with other components of the cropping system,

including the nutrient management and pest management provisions of the conservation plan.

Avoid using plants that are on the state's noxious weed or invasive species lists.

Cover crops will be terminated by harvest, frost, mowing, tillage, crimping, and/or herbicides in preparation for the following crop.

Herbicides used with cover crops will be compatible with the following crop.

Cover crop residue will not be burned.

Application of this practice, including seedbed preparation, should be done in accordance with FOTG: Sec. IV: 550DP: Herbaceous Vegetation Design Procedures.

Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for selecting an appropriate cover crop to meet the planned use, and detailed information for seeding rates and dates.

Additional Criteria to Reduce Erosion from Wind and Water

Cover crop establishment, in conjunction with other practices, will be timed so that the soil will be adequately protected to control erosion to within the soil loss tolerance (T) or other planned soil loss objectives.

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection.

The amount of surface and/or canopy cover needed from the cover crop shall be determined using current erosion prediction technology.

Additional Criteria to Increase Soil Organic Matter Content

Cover crop species will be selected on the basis of producing high volumes of organic material

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

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and or root mass to maintain or improve soil organic matter.

The NRCS Soil Conditioning Index (SCI) procedure will be used to determine the amount of biomass, type of cover crop, type of cropping system, tillage system and other management practices required to have a positive trend in the soil organic matter subfactor. Refer to other appropriate practice standards such as Residue Management No-Till/Strip Till (329) and Conservation Crop Rotation (328) for requirements of other practices.

The cover crop will be terminated as late as feasible to maximize plant biomass production, considering the time needed to prepare the field for planting the next crop and soil moisture depletion.

Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for guidance on selecting the appropriate cover crop, planting dates and seeding rates.

Additional Criteria to Capture and Recycle Excess Nutrients in the Soil Profile

Cover crops will be established and actively growing before the expected period(s) of nutrient leaching.

Cover crop species will be selected for their ability to take up large amounts of nutrients from the rooting profile of the soil. Winter annual cover crops such as rye or wheat or other appropriate cover crops that have at least six weeks of potential growth and will produce adequate biomass before a killing frost will be utilized for this purpose after the harvest of spring planted crops. Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) to determine the most appropriate cover crops to tie-up and recycle nutrients, seeding rates and seeding dates. Refer to Chapter 6 of the Agricultural Waste Management Field Handbook or the NRCS Plants Database, Crop Nutrient Tool to determine the amount of nutrients tied-up/utilized by various cover crops.

Cover crops will be killed early enough to ensure that the nutrients are available at the proper time for the following crop.

If excess nutrients in the soil profile are more than the cover crop can tie-up, the cover crop will be harvested in order to remove the maximum amount of excess nutrients.

Additional Criteria to Promote Biological Nitrogen Fixation

Only legumes or legume-grass mixtures will be established as cover crops.

The specific Rhizobium bacteria for the selected legume will either be present in the soil or the seed will be inoculated at the time of planting.

Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for selecting appropriate legumes, seeding dates and rates.

Nitrogen credits from legume cover crops will be accounted for in the nutrient management plan.

Additional Criteria to Increase Biodiversity

Cover crop species shall be selected that have different maturity dates, attract beneficial insects, increase soil biological diversity, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management.

The cover crop species selected, or at least a portion of the cover crop mix, shall be a different crop type than the previous crop (i.e. cool season grass, warm season grass, cool season broadleaf, warm season broadleaf). Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for additional guidance on selecting the appropriate cover crop to maximize biological diversity.

Additional Criteria for Weed Suppression

Species for the cover crop will be selected for their chemical or physical characteristics to suppress or compete with weeds.

Cover crops residues will be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects. Cover crops with allelopathic effects are identified in Table 1a.

For long-term weed suppression, allow annual cover crops such as rye, and/or biennial species such as sweet clover to reseed themselves.

Additional Criteria to Provide Supplemental Forage

Species selected will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop. Species such as oats, triticale, rye, turnips, rape, millet, or forage sorghum can be planted after early harvested crops such as wheat, soybeans, or corn silage to provide supplemental forage.

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Forage provided by the cover crop may be hayed or grazed as long as sufficient biomass is left for resource protection.

Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for selecting an appropriate cover crop to provide supplemental forage and for seeding rates and dates. Additional information on selecting cover crops is also found in the considerations section of this standard.

Additional Criteria for Soil Moisture Management

When lack of soil moisture is a concern terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Terminated cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible before terminating to maximize soil moisture removal.

Additional Criteria to Reduce Particulate Emissions into the Atmosphere

Manage cover crops and their residues so that at least 80% ground cover is maintained after planting operations for the following crop.

Wind erosion must be controlled to soil loss tolerance T or less if targets are set for the area. The current wind erosion prediction technology in Section I of the FOTG will be used.

Additional Criteria to Minimize and Reduce Soil Compaction

Select and manage cover crop species that will produce deep roots and large amounts of surface or root biomass to increase soil organic matter, improve soil structure and increase soil moisture through better infiltration. Refer to Tables 1 and 1a or the Cover Crop Design Worksheet (NE-CPA-7) for selecting an appropriate cover crop to reduce soil compaction and for seeding rates and dates.

CONSIDERATIONS

Plant cover crops in a timely manner according to dates listed on Table 1a to establish a good stand. Cover crops can be aerially seeded prior to crop harvest when necessary.

The type of cover crop selected depends on the purpose, or purposes, for which it is being grown. Close seeded high biomass crops such as oats, rye, wheat, sorghum or sudangrass are ideal for protecting the soil surface, controlling soil erosion, and increasing soil organic matter content. This is especially important following crops that provide little residue cover such as soybeans or corn silage. A minimum of 6-8 inches of growth is required for erosion control but 12 inches or more is optimal. To maximize erosion control and biomass production, maintain an actively growing cover crop as late as feasible to maximize plant growth.

Deep-rooted annual cover crop species such as wheat, rye or forage sorghum capture and recycle nutrients that might otherwise be lost to leaching. Oilseed radishes and turnips are also good nutrient scavengers and will recycle nutrients more quickly than the grass type cover crops.

The timing of cover crop termination for nutrient cycling depends on the type of cover crop and the method of termination. Cover crops with a low carbon to nitrogen (C:N) ratio, such as legumes and other broadleaves, decompose and release nutrients more rapidly than cover crops with high C:N ratios, such as grass type cover crops, especially if the grass type cover crops are allowed to grow beyond boot stage.

Incorporating the cover crop with tillage generally speeds decomposition and nutrient release but if the decomposition occurs too rapidly the nutrients may be lost to leaching or the soil organisms may temporarily tie up nutrients in the soil resulting in early season nutrient deficiencies. Cover crops that are left on the surface generally decompose more slowly and release nutrients to the growing crop throughout the growing season.

Consider the potential of the cover crop to harbor disease or insect pests that might affect the following crop.

Consider how a cover crop fits the current herbicide program including the potential impact of herbicide carryover on the cover crop and options for controlling the cover crop in the following crop should escapes occur.

Consider the impact of the cover crop on available soil water for the following crop. In determining the impact on available water, consider the water holding capacity of the soil, the amount of water used by the cover crop, and

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the potential rainfall after the cover crop is terminated.

Be aware of potential allelopathic effects. While allelopathic effects may be beneficial for weed control they may also inhibit establishment and growth of the following crop.

Summer annual cover crops may be used to improve site conditions for grass establishment. When planted for this purpose, plant the cover crop in July through mid-August to achieve 12-18 inches of growth prior to killing frost. If necessary, remove excess growth in time to allow for re-growth. For additional information refer to Herbaceous Vegetation Design Procedures (550DP).

Oats or other spring small grains may be planted as companion crops with cool season grasses or legumes in order to accelerate cover establishment but should not be planted at a rate that inhibits the establishment of the planned seeding.

Cover crop mixtures (sometimes referred to as cocktails) provide greater benefits and often perform better when compared to a single species. Mixtures increase biodiversity and can address multiple objectives such as reducing compaction, scavenging nutrients, and increasing soil organic matter. They can also attract beneficial insects and provide food and cover for wildlife. Select the cover crop species to be included in the mix based on the intended purpose. Selecting species of different types (See Table 1a) will maximize benefits.

Flowering species such as legumes are ideal for pollinators.

Cover crops are an essential component of organic cropping systems to control erosion, capture and recycle nutrients, and control pests. Including cover crops can reduce the need for tillage and improve or maintain soil quality.

Cover crops are also a valuable component of no-till cropping systems. Incorporating cover crops into a no-till system can reduce the need for pesticides and will enhance soil quality by increasing biological diversity and building soil organic matter. Cover crops will have the greatest impact on crop production and soil health when combined with a continuous no-till system.

PLANS AND SPECIFICATIONS

Plans and specifications will be prepared for the practice site using the Cover Crop Design

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Section IV

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Worksheet (NE-CPA-7) or equivalent. Plans for the establishment of cover crops shall include:

- Species or species of plants to be established.
- Purpose of cover crop (refer to Table 1)
- Type of planting/tillage system to be used (e.g. no-till drill)
- Seeding rates.
- Recommended seeding dates.
- Establishment procedure.
- Planned rate, timing and type/form of nutrient application.
- Planned dates for killing cover crop (if applicable).
- Other information pertinent to establishing and managing the cover crop.

Plans and specifications for the establishment and management of cover crops may be recorded in narrative form, on job sheets, or on other forms designed to provide specific requirements for the practice.

Fertilization

- The recommended rate of fertilizer for plants used should be based on soil test results and the Nutrient Management Standard (590).
- In cases where time is lacking to make a soil test, a general recommendation is 20 lbs of Nitrogen in Vegetative Zones I and II and 40 lbs Nitrogen in Vegetative Zones III and IV for small grain cover crops.
- When establishing legume cover crops, special consideration shall be given to pH and Phosphorous levels. Recommendations on liming and P fertilizer application will be based on soil tests and the Nutrient Management Standard (590).

OPERATION AND MAINTENANCE

Control growth of the cover crop to reduce competition from volunteer plants and shading.

Ensure that cover crops do not become invasive and that cover crops are compatible with planned crops/vegetation.

Control weeds in cover crops by mowing, with herbicides, or by using other pest management techniques.

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Manage soil moisture depletion by selecting species that use little soil moisture, and by killing the cover crop before excessive transpiration occurs.

REFERENCES

Bowman, G., C. Cramer, and C. Shirley. A. Clark (ed.). 1998. Managing cover crops profitably. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 3. National Agriculture Library. Beltsville, MD.

Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

NRCS Nebraska Conservation Planning Form, Cover Crop Design Worksheet, NE-CPA-7: [http://efotg.nrcs.usda.gov/references/public/NE/NE-CPA-7\(Cover_Crop_Design_Worksheet\).xls](http://efotg.nrcs.usda.gov/references/public/NE/NE-CPA-7(Cover_Crop_Design_Worksheet).xls)

NRCS Nebraska Vegetative Zone Map: <http://efotg.nrcs.usda.gov/references/public/NE/NebraskaVegetativeZones.pdf>

NRCS Nebraska Herbaceous Vegetation Design Procedures (550 DP) <http://efotg.nrcs.usda.gov/references/public/NE/NE550DP.pdf>

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook. 1992. Last Revised June 1999.

NRCS Plants Database, Crop Nutrient Tool, http://npk.nrcs.usda.gov/nutrient_body.html

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Table 1: Cover crop suitability for selected uses and their relative water use and carbon to nitrogen (C:N) ratio

Cover Crop	Erosion ^{1/} Reduction	Increase soil organic matter	Capture, recycle, and redistribute nutrients	Promote biological nitrogen fixation	Weed suppression ^{2/}	Provide supplemental hay	Provide supplemental grazing	Plant Water Use	Reduce soil compaction	C:N Ratio	Attract Beneficial Insects	Provide seedbed for grass seeding
alfalfa	G	G	G	Y	G	F	F	H	G	L	Y	P
barley	G	G	F	N	G	F	F	M	F	M	Y	F
buckwheat	G	F	G	N	G	P	P	L	P	L	Y	P
canola /rapeseed	F	F	G	N	P-G	F	F	M	G	L	Y	P
chickling vetch	G	F	G	Y	F	F	F	L	F	L	Y	P
chickpea	P	P	P	Y	F	G	F	L	P	L	Y	P
corn	G	G	G	N	P-G	F	F	H	G	H	N/A	G
cowpea	P	P	F	Y	G	F	F	L	F	L	Y	P
field pea / lentil	P	P	P	Y	F	G	F	L	P	L	Y	P
flax	F	F	F	N	P	P	P	M	P	H	N/A	P
hairy or crown vetch	G	F	F	Y	P	F	F	M	F	L	Y	P
ladino (white) clover	G	F	G	Y	G	F	F	L	P	L	Y	P
millet, foxtail	F	F	F	N	F	G	F	L	F	M	N	F
millet, pearl	G	G	F	N	G	G	F	L	F	M	N	F
millet, proso	F	F	F	N	F	F	F	L	P	M	N	F
mustard, brown, oriental or yellow	F	F	F	N	G	F	F	M	F	L	Y	P
oats	G	G	F	N	F	G	F	M	F	M	N	F
radish	P	P	G	N	G	P	G	H	G	L	Y	P
red clover	G	F	G	Y	G	F	F	L	P	L	Y	P
rye (cereal)	G	G	G	N	G	F	F	H	F	M	Y	P
ryegrass (annual)	G	G	G	N	G	F	F	H	G	M	Y	F
ryegrass (Italian)	G	G	G	N	G	G	G	H	F	M	Y	P
safflower	F	F	G	N	F	F	G	H	F	M	N	P
sorghum, grain or forage	G	G	G	N	G	G	F	M	G	M	Y	G
soybean	P	P	F	Y	P-G	F	F	M	P	L	N/A	G
sudangrass, sudan-sorghum hybrid	G	G	G	N	G	G	G	M	G	M	Y	G
sunflower	F	F	G	N	F	P	G	M	F	M	N/A	P
sweet clover	G	F	F	Y	F	P						

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Table 1a: Cover crop adaptation, seeding rates, planting dates and additional properties

Cover Crop	Vegetative Zones	Seeding Rates ^{2/}	Planting Time ^{3/}	Type ^{4/}	Winter Hardy ^{5/}
Alfalfa	All	8-12 lbs/ac	4/1-5/15 or 8/15-9/15	CB (P, L)	Yes
Barley	All	1-2 bu/ac	3/15-5/15 or 8/01-9/15 (cover crop or forage only)	CG*	Spring barley: No Winter barley: to -20° F
Buckwheat	All	40-50 lbs/ac	7/1-8/1	WB*	No
Canola/ Rapeseed	All	4-6 lbs/ac	3/15-4/15 or 8/22-9/12	CB (Br)*	to -20° F
Chickling Vetch	All	70 lbs/ac	3/15-4/15	CB (L)	
Chickpea	I, II	95-100 lbs/ac	4/15-5/15	CB (L)*	No
Corn	III, IV	15-25 lbs/ac	5/15-8/15	WG	No
Cowpea	III, IV	30 lbs/ac	6/1-7/15	WB (L)	
Field Pea / lentil	I, II	80-100 lbs/ac	3/15-4/15	CB (L)	No
Flax	All	40-50 lbs/ac	4/20-5/10	CB	No
Hairy or Crown Vetch	II, III, IV	15-20 lbs/ac	8/01-9/15 or 11/01-5/15	CB (L)*	to -20° F
Ladino (white) Clover	III, IV	2-3 lbs/ac	8/15-9/15	CB (P, L)*	to -10° F
Millet, Foxtail	All	10-20 lbs/ac	5/15-8/15	WG	No
Millet, Pearl	All	5-15 lbs/ac	5/15-8/15	WG	No
Millet, Proso	All	20-30 lbs/ac	5/15-8/15	WG	No
Mustard (brown, oriental or yellow)	I, II	3-6 lbs/ac	3/15-4/1	CB (Br)*	No
Oats	I, II	2-3 Bushels (1/2-1 bushel when used as a companion crop with cool season grass plantings)	3/15-5/1 or 8/1-9/1 (cover crop or forage only)	CG*	No (tolerates slightly below 32° F)
Oats	III, IV	2-3 Bushels (1/2-1 bushel when used as a companion crop with cool season grass plantings)	3/15-5/15 or 8/1-9/15 (cover crop or forage only)	CG*	No (tolerates slightly below 32° F)

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Radish	I, II	8-14 lbs/ac	7/15-8/20 (can be planted in March, but is best suited to be planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CB (Br)	No
Radish	III, IV	8-14 lbs/ac	7/1-9/1 (can be planted in March, but is best suited to be planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CB (Br)	No
Red Clover	III, IV	6-8 lbs/ac	8/15-9/15 or 3/15-5/15	CB (P, L)*	to -20° F
Rye	I, II	1-2 bu/ac	8/1-9/15 or 3/15-5/15	CG*	Yes (-30° F)
Rye	III, IV	1-2 bu/ac	8/1-10/15 or 3/15-5/15	CG*	Yes (-30° F)
Ryegrass (annual)	All	20-30 lbs/ac	3/15-5/15 or 8/01-9/15	CG*	to 0° F
Ryegrass (Italian) ^{6/}	All	20-30 lbs/ac	3/15-5/15 or 8/01-9/15	CG*	to 0° F
Safflower	All	15-30 lbs/ac	4/20-5/10	WB	No
Sorghum, Grain or Forage	All	10-15 lbs/ac	5/15-8/15	WG*	No
Soybeans	III, IV	1 bu/ac	6/1-7/15	WB (L)	No
Sudangrass, Sorghum-Sudan Hybrid	All	20-30 lbs/ac	5/15-8/15	WG*	No
Sunflower	II, III, IV	4 lbs/ac	5/15-8/16	WB*	No
Sweet Clover	All	8-10 lbs/ac	8/1-9/15 or 11/1-5/15	CB (B, L)*	to -20° F
Triticale	I, II	1-2 bu/ac	8/1-9/15	CG	to -20° F
Triticale	III, IV	1-2 bu/ac	8/1-10/15	CG	to -20° F
Turnips	I, II	2-4 lbs/ac	7/15-8/20 (can be planted in March, but is best suited to be planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CB (Br)	to -20° F Provides growth down to 15° F (turns dormant below this temp)
Turnips	III, IV	2-4 lbs/ac	7/1-9/1 (can be planted in March, but is best suited to be planted in late summer following wheat harvest for double cropping, early harvested crops, or aerially applied prior to crop harvest).	CB (Br)	to -20° F Provides growth down to 15° F (turns dormant below this temp)
Wheat (winter)	I, II	1-2 bu/ac	8/15-9/15 or 3/15-5/15	CG*	to -20° F
Wheat (winter)	III, IV	1-2 bu/ac	8/15-10/15 or 3/15-5/15	CG*	to -20° F

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1/ Hairy and crown vetch can become invasive in some areas. Rye cover crops should be avoided in areas where wheat is grown. Cover crop selected must be adapted to the soil and site conditions.

2/ Rate of seeding is dependent upon the purpose of the planting and available soil moisture, or if the site is irrigated. If seed is broadcasted/aerial applied the highest rate of seeding should be used. Other practice specifications may apply (i.e. 645 Wildlife Food Plot) and should be consulted for seeding rate guidance.

3/ Later planting dates should be avoided when soil moisture is lacking and/or select cover crops that are the most conducive to drought conditions.

4/ Type: CB=cool season broadleaf; CG=cool season grass; WB=warm season broadleaf; WG=warm season grass; (B)=biennial; (P)=perennial; (Br)=brassica; (L)=legume; * Crops with potential allelopathic affects

5/ Winter hardiness will vary by variety.

6/ Unlike Annual Ryegrass, Italian Ryegrass behaves somewhat like a biennial and will sometimes over winter and produce seed the following spring or summer. Some varieties may last for several years and have to be killed with a burndown herbicide.